HS
Horizontal, Single-stage End Suction Pumps

Installation and operating instructions

Please leave these instructions with the pump for future reference.

CONTENTS

SAFETY WARNING

Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

Shock Hazard

A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

PLEASE KEEP THESE INSTRUCTIONS WITH THE PUMP FOR FUTURE REFERENCE.

Preinstallation checklist

Your Grundfos HS End Suction pump is of the utmost quality. Combined with proper installation, your Grundfos pump will give you many years of reliable service.

To ensure the proper installation of the pump, carefully read the complete manual before attempting to install the pump.

Check the condition of the pump

Examine your pump carefully to make sure that no damage has occurred during shipment.

Your Grundfos HS pump should remain in its shipping carton until it is ready to be installed. This carton has been specially designed to protect the pump from damage. During unpacking and prior to installation, care should be taken to ensure the pump is not dropped or mishandled. Immediately report any damage in writing to the transportation company and ask to have it inspected. Do not destroy packing materials until the shipment is inspected and the claim is settled.

The position of the coupling (that connects the pump shaft to the motor shaft) is set at factory specifications. No adjustment is necessary or advised. Refer to "Motor Replacement" on page 6 for proper coupling positioning procedures.

Applications and operating ranges

Before installing the pump, the following checks should be made to ensure that the proper operating conditions for the pump are present.

Applications

The HS end suction pump is a general service pump designed to pump fluids in a wide range of applications.

Acceptable fluids include:

- Hot and cold water
- Clean, thin, non-aggressive and non-explosive fluids
- Consult manufacturer for fluids containing chlorine or hydrocarbons

Operating Ranges

- Maximum fluid temperature: 180°F continuous
211°F intermittent
- Maximum working pressure: 125 PSIG
- Maximum ambient temperature: 104°F (40°C)

Consult manufacturer for higher ambient temperature conditions.

Installation

Pump location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variations in temperature. Care must be taken to ensure that the pump is mounted at least 6 inches from any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and adequate space to remove the motor for repair.

For open systems requiring suction lift, the pump should be located as close to the water source as possible to reduce piping losses.

Foundation

Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump in order to minimize noise and vibration in the system. It is not recommended to hang the pump unit in the system piping without added support. Bolt hole center line dimensions for the various pump types are given in Figure 1 on page 3. Secure the pump to the foundation using all four bolt holes. Uneven surfaces can result in pump base breakage when the mounting bolts are tightened.

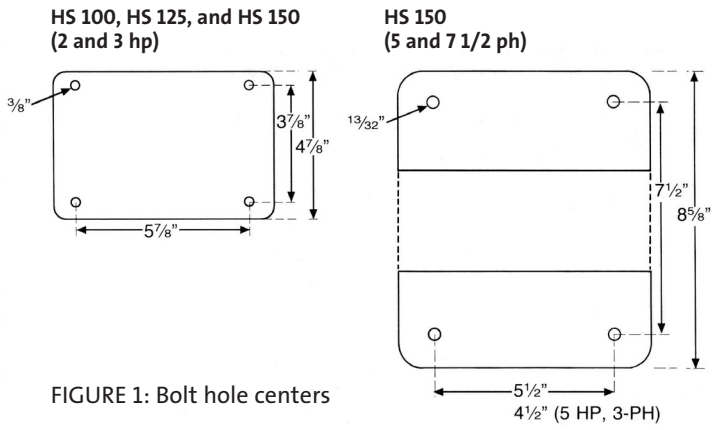


FIGURE 1: Bolt hole centers

Pipework

The use of pipe compound or teflon tape on all male threads is acceptable as a means of providing a positive seal at the pump port conditions. Avoid using unnecessary fittings, valves or accessory items, especially in the vicinity of the pump suction and discharge ports. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump.

Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. If possible, the pump should not be installed at the lowest point in the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used to prevent its entry into the pump.

Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum. This would generally dictate that the suction piping, fittings, valves and accessories be at least as large as the suction port connection of the pump. These should be larger if the distance to the water source is great.

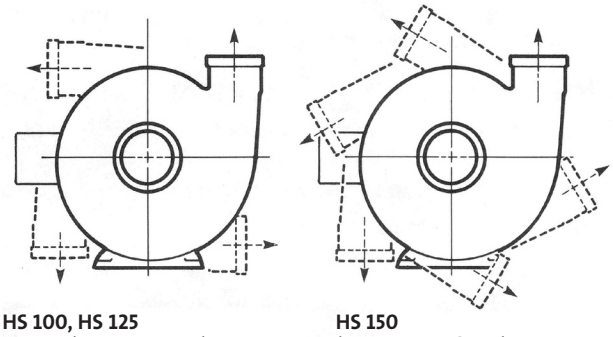
Care should be taken to provide a means of pump isolation (e.g., gate or butterfly valves) in applications where the pump is in a pressurized or flooded suction condition.

If the pump is installed in a suction lift application, horizontal suction piping must rise gradually from the source to the pump and contain no high spots which allow air pockets to form.

Discharge piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves, and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce fluid velocities and pipe friction losses. Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure. Before the pump is installed, it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

The standard discharge position for Grundfos Series HS pumps is vertical (upward). To simplify pumping connections, however, the pump volute may be rotated to optional positions. The HS 100, HS 125, and HS 150 (2 HP and 3 HP) models may be rotated to any of four positions while the HS 150 (5 HP and 7½ HP) may be rotated to any of six positions. (See Figure 2).



HS 100, HS 125
HS 150 (2 hp and 3 hp)
(4) discharge positions

HS 150
(5 hp and 7 1/2 hp)
(6) discharge positions

FIGURE 2: Piping connection positions
(viewed from suction end)

Reposition the pump volute as follows:

1. Loosen and remove each of the cap screws that attach the pump volute to the motor stool.
2. Carefully lift the pump volute off of the motor stool and rotate it to the required position. Check that the o-ring is properly seated.
3. Apply teflon sealant to the cap screw threads.
4. Reinstall the cap screws and tighten diagonally and evenly.

Bypass

A bypass or pressure relief valve should be installed in the discharge pipe if there is any possibility that the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure that adequate cooling and lubrication of the pump is maintained. See Table A on page 4 for minimum flow rates.

TABLE A: Minimum Pumping Rates

Pump Type	Minimum Flow Rates
HS 100 (all)	3 U.S. GPM
HS 125 (all)	4 U.S. GPM
HS 150 2020	8 U.S. GPM
HS 150 3030	10 U.S. GPM
HS 150 5050	12 U.S. GPM
HS 150 7575	13 U.S. GPM

Electrical

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electric Code and local codes and regulations.

WARNING: The safe operation of this pump requires that it be grounded in accordance with the National Electric Code and local governing codes or regulations. Connect the ground wire to the grounding screw in the terminal compartment and then to the acceptable grounding point.

Motor

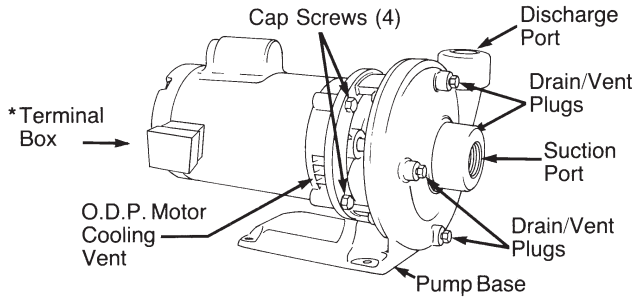
Grundfos HS pumps are supplied with heavy-duty 2-pole 3450 RPM, ODP or TEFC NEMA C frame motors selected to our rigid specifications. Motors have been selected to operate without exceeding their service factor ratings. Motors with other enclosure types and for other voltages and frequencies are available on a special order basis. If you are replacing the pumping unit, but using a motor supplied separately, be sure to read the "Motor Replacement" instructions on page 6 for proper adjustment of the pump shaft.

Motor mounting position

Motors up to 3 HP can be mounted in any of four positions in 90° steps. To rotate the motor:

1. Remove the four cap screws securing the motor to the pump.
2. Turn the motor to the desired position.
3. Replace the motor and securely tighten the four bolts.

Note: ODP motors through 3 HP are supplied with cooling vents. These motors should remain mounted with the cooling vents positioned downward, especially where there is the possibility that liquid might splash onto the pump from above (i.e., rain).



*Standard motor position is the 9 o'clock position as shown. All motors include a terminal box.

FIGURE 3: Motor mounting positions

Supply power

Verification of the electrical supply should be made to be certain the voltage, phase, and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate.

These motors are designed to run on + or - 10% of the nameplate rated voltage.

Wiring connection diagrams can be found on the plates attached to the motor.

WARNING: If voltage variations are larger than + or - 10%, DO NOT operate the pump.

Field wiring

Wire sizes should be based on the current carrying properties of a conductor as recommended by the latest edition of the National Electric Code or local regulations.

Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of the pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer, resistant starter, or soft start should be used.

It is recommended that a fused disconnect be used for each pump where service and standby pumps are installed.

Motor protection

SINGLE-PHASE MOTORS

Single phase Series HS pumps are equipped with multi-voltage, squirrel cage induction motors with built-in thermal protection.

THREE-PHASE MOTORS

HS pumps with three-phase motors must be used with the proper size and type of motor starter to ensure that the motor is protected against damage from low voltage, phase failure, current imbalance, and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used.

The overload should be sized and adjusted to the current rating of the motor.

Under no circumstances should the overloads be set to a higher value than the service factor current shown on the motor nameplate. This will void the warranty.

Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer.

Pump Startup

Priming the pump and venting the system

After the pump has been installed, wired and the system filled, the following procedures should be performed.

CAUTION: Do not start the pump before priming and venting the pump. Never operate the pump dry.

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and remove the topmost drain/vent plug from the front of the pump volute. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out of the open plug. Replace the plug and securely tighten. Completely open the isolation valves.

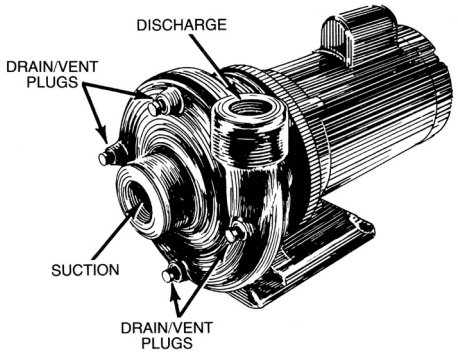


FIGURE 4: Priming the pump and venting the system

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of all air before starting the pump. This is best accomplished through the discharge port or an opening in the discharge piping at a level above the pump volute. Remove the topmost drain/vent plug. Pour water into the discharge until the suction piping and pump are completely filled. If the suction piping does not slope downward from the pump toward the water level, the air in the line must be purged while the system is being filled. Replace the drain/vent plug and securely tighten. Connect and/or seal the discharge piping.

Check motor rotation

1. Make sure power is off.
2. Check to make sure the pump has been filled and vented.
3. Rotate the pump shaft to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Briefly switch the power on and observe the direction of rotation. **When viewed from the motor end, the pump should rotate CLOCKWISE.** (NOTE: Direction of rotation on HS pumps is opposite that of CR, LM/LP and VersaFlo TP pumps).
6. To reverse the direction of rotation, first switch off the supply power.
7. On the three-phase motors, interchange any two power leads on the load side of the starter. On single-phase motors, see the connection diagram on the motor and change the wiring as required.
8. Repeat step 3 to ensure that improper rotation has not unthreaded the impeller from the pump shaft.
9. Switch on the power and again check the motor for proper rotation.

Starting and adjusting

Before starting the pump, be sure to check:

1. Pump is primed.
2. Direction of rotation is COUNTERCLOCKWISE when viewed from the suction port.
3. All piping connections are tight and pipes are adequately supported.
4. Suction line isolation valve is completely open (if valve is installed).
5. For initial starting, the isolation valve in the discharge pipe should be closed and gradually opened after the pump is turned on. Opening this valve too fast may cause water hammering in the discharge pipe. Unless the discharge valve is being used as a flow throttling device, make sure the valve is completely open.
6. Check and record the voltage and amperage of the motor. Adjust the motor overloads if required.
7. Check and record operating pressures, if pressure gauges have been installed.

8. Check all controls for proper operation. If the pump is controlled by a pressure switch, check and adjust the cut-in and cut-out pressures. If low-water-level controls are used, be sure the low-water-level switch is properly adjusted so the pump cannot run if the pump should break suction.

Operation and maintenance

Operation

When Grundfos HS centrifugal pumps are installed in accordance with these instructions and sized for correct performance, they will operate efficiently and provide years of service. The pumps are water lubricated and do not require any external lubrication or inspection. The motors may require periodic lubrication as noted in the following maintenance information.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump.

This can result in motor and pump damage due to overheating. A properly sized relief valve or bypass line should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

Pump cycling should be checked to ensure the pump is not starting more than 20 times per hour on ½ HP to 5 HP models or 15 times per hour on 7 ½ HP models. Rapid cycling is a major cause of premature motor failure due to increased heat build-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

Freeze protection

If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves and remove the drain/vent plugs at both the top and bottom of the pump volute. DO NOT replace the plugs until the pump is to be used again.

Maintenance

Motor lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings have sealed bearings that cannot be re-lubricated. Motors with grease fittings should only be lubricated with approved types of grease. Do not overgrease the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Severity of Service	Ambient Temperature (Maximum)	Environment	Approved Types of Grease
Standard	+104°F (+40°C)	Clean, little corrosion	See motor nameplate for grease type or compatible equivalent type of grease
Severe	+122°F (+50°C)	Moderate dirt, corrosion	
Extreme	>+122°F (+50°C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

Motor lubrication schedule

NEMA Frame Size 56 to 210

Severity of Service	Interval (Hours)	Weight of Grease to Add (oz)	Volume of Grease to Add (in^3/tspn)
Standard	5500	0.3	0.6/2
Severe	2750		
Extreme	550		

Preventative maintenance

At regular intervals, depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check until control cycling twice and adjust if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.

If the pump fails to operate or there is a loss of performance, refer to pages 11 - 13, “Troubleshooting.”

Motor replacement

If the motor is damaged as a result of bearing failure, burning, or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on HS pumps are specifically selected to our rigid specifications. **Replacement motors must be of the same NEMA C frame size and have the same service factor.**

Failure to follow these recommendations may result in premature motor failure.

Disassembly

1. Using the proper allen wrench, loosen the set screw(s) in the coupling.
2. With the correct size wrench, loosen and remove the four bolts which hold the motor to the discharge section of the pump end motor support.
3. Move the motor straight back until the shaft is free from the coupling.

Assembly

1. If not already done, disconnect the motor stool from the pump volute by removing the cap screws which join the two together. Carefully pull the motor stool and rotating assembly out of the pump volute.
2. Thoroughly clean the surfaces of the motor and pump end mounting flanges.
3. Place the stub shaft onto the end of the motor shaft. Connect the motor and motor stool by inserting the mounting bolts and tightening them diagonally and evenly (torque 15 to 20 ft. lbs.).
4. Using the appropriate edge of impeller spacing tool SV00201 (see Table C), position the impeller at the correct axial location and tighten allen shaft set screw(s) into the motor shaft's keyway (see Figures 5A, B & C).
5. Attach the motor stool to the pump volute with the cap screws, ensuring that the terminal box or conduit connection and the pump's discharge port are correctly oriented for your installation. Replace the attaching cap screws and torque to 25 ft. lbs.
6. Be certain the pump shaft can be rotated by hand. If shaft cannot be rotated or it binds, repeat steps 4 and 5.

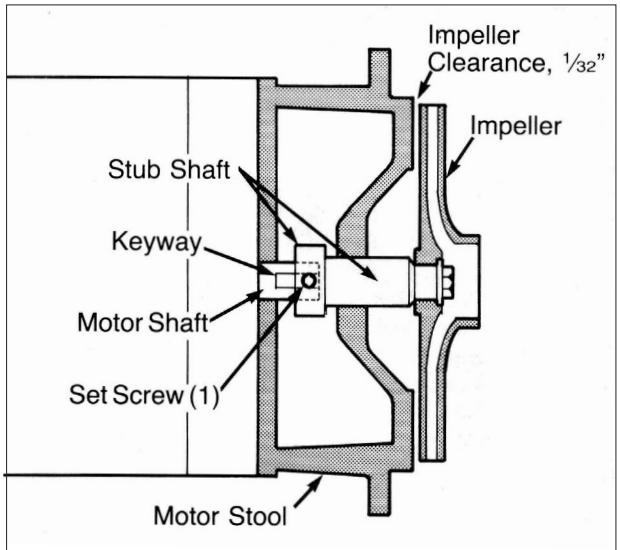


FIGURE 5A: Pump assembly (HS 100 and HS 125)

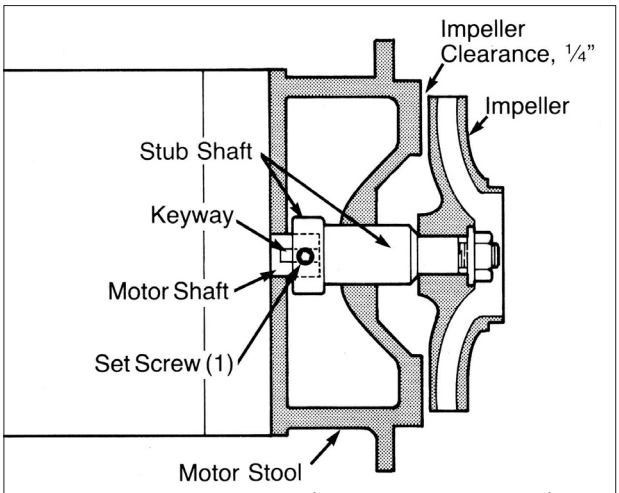


FIGURE 5B: Pump assembly (HS 150 2020 and 3030)

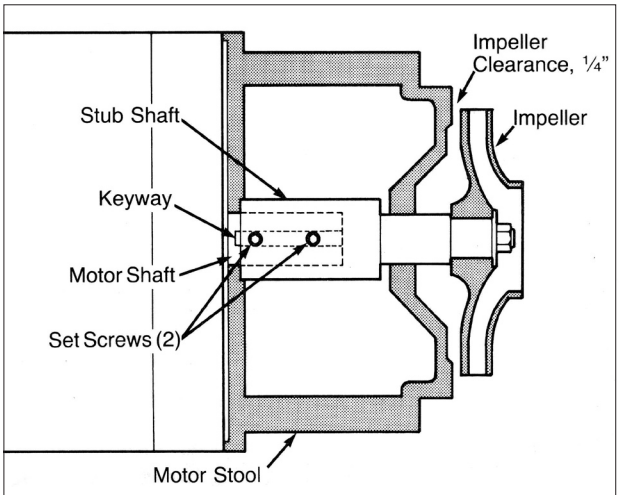


FIGURE 5C: Pump assembly (HS 150 5050 and 7575)

TABLE C: Impeller - Motor Support Positioning

Pump Model(s)	Impeller Distance to Motor Support
HS 100 (all)	1/32"*
HS 125 (all)	1/32"*
HS 150 (2020 & 3030)	1/4"*
HS 150 (5050 & 7575)	1/4"*

* Use Spacing Tool SV00201 included in seal kits and repair kits (thin edge = 1/32", thicker edge = 1/4")

Spacing Tool SV00201

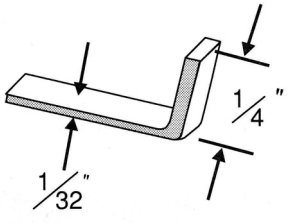


TABLE D: Repair Kits

Shaft Seal & Gasket Kits	
HS 100 & 125 (Buna-N)	Part No. 47U08900
HS 100 & 125 (FKM)	Part No. 47U08901
HS 150 (Buna-N)	Part No. 47U08903
HS 150 (FKM)	Part No. 47U08904
Repair Kits	
HS 100 & 125 (Buna-N)	Part No. 47U08906
HS 100 & 125 (FKM)*	Part No. 47U08907
HS 150 2020 & 3030 (Buna-N)	Part No. 47U08909
HS 150 2020 & 3030 (FKM)*	Part No. 47U08910
HS 150 5050 & 7575 (Buna-N)	Part No. 47U08912
HS 150 5050 & 7575 (FKM)*	Part No. 47U08913

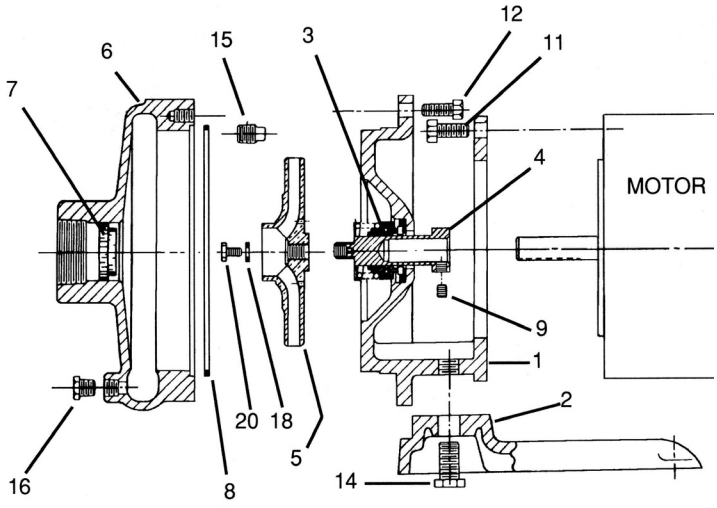
*Includes 416ss Stub Shaft

Repair Kits consist of the shaft seal and gasket kit, stub shaft, and hardware. Impellers must be ordered separately.

REFER TO THE KITS AND SPARE PARTS PRICE LISTS FOR A COMPLETE LISTING OF KIT COMPONENTS

Part Lists and Diagrams (Model B)

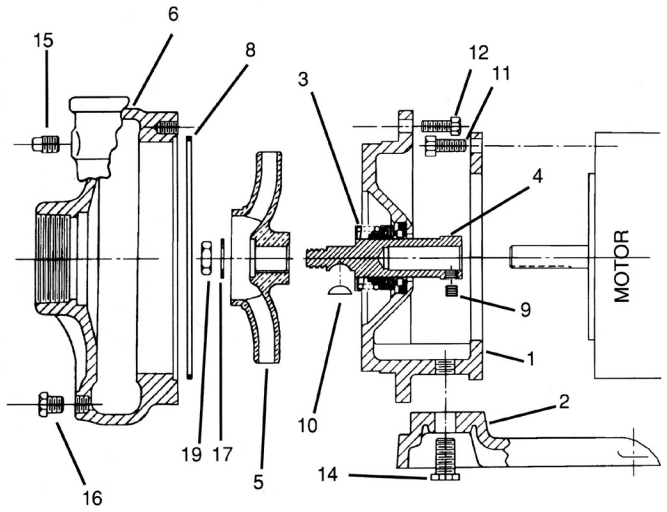
HS 100 0505 to HS 125 1515



Pos.No.	Description	# Used	Part No. *
1	Motor Stool, 56C Frame	1	47U09000
2	Pump Base	1	47U09006
3	3/4" Type 21 John Crane Seal	1	See Kits
4	Stub Shaft	1	Brass-47U09013 416ss-47U09014
5	Impeller - HS 100 0505 Impeller - HS 100 0707 Impeller - HS 125 1010 Impeller - HS 125 1515	1	47U09020 47U09025 47U09030 47U09035
6	Pump Volute - HS 100 Pump Volute - HS 125	1	47U09065 47U09066
7	Steal Ring	1	47U09075
8	Volute Gasket	1	See Kits
9	Shaft Set Screw	1	See Kits
11	3/8-16 x 3/4" Cap Screws	4	See Kits
12	5/16-18 x 3/4" Cap Screws	4	See Kits
14	1/2-13 x 11/4" Cap Screw	1	See Kits
15	1/4" NPT Pipe Plug (for discharge tap)	1	See Kits
16	1/8" Pipe Plugs	4	See Kits
18	Washer	1	See Kits
20	Cap Screw	1	See Kits

Part Lists and Diagrams (Model B)

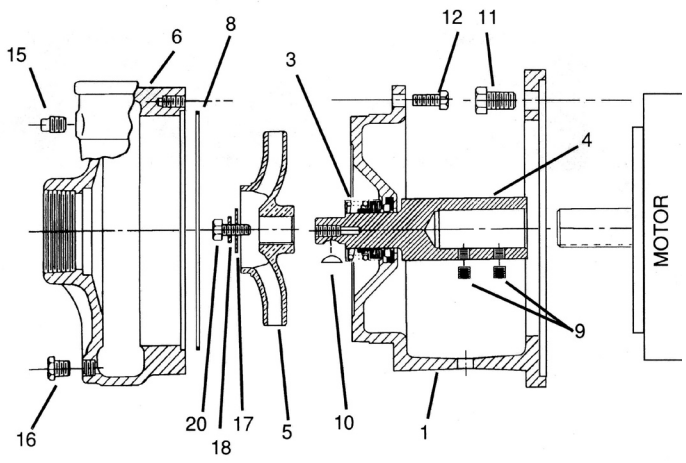
HS 150 2020 to HS 150 3030



Pos.No.	Description	# Used	Part No. *
1	Motor Stool, 56C Frame	1	47U09002
2	Pump Base	1	47U09006
3	1" Type 21 John Crane Seal	1	See Kits
4	Stub Shaft, 416ss	1	47U09016
5	Impeller - HS 150 2020	1	47U09045
	Impeller - HS 150 3030		47U09050
6	Pump Volute	1	47U09067
8	Volute Gasket	1	See Kits
9	5/16-18 x 3/8" Shaft Set Screw	1	See Kits
10	Woodruff Key	1	See Kits
11	3/8-16 x 3/4" Cap Screws	4	See Kits
12	5/16-18 x 3/4" Cap Screws	4	See Kits
14	1/2-13 x 11/4" Cap Screw	1	See Kits
15	1/4" Pipe Plug	1	See Kits
16	1/8" Pipe Plugs	4	See Kits
17	Impeller Washer	1	See Kits
19	Impeller Lock Nut	1	See Kits

Part Lists and Diagrams (Model B)

HS 150 5050 & HS 150 7575



Pos.No.	Description	# Used	Part No. *
1	Motor Stool, 182TC/184TC	1	47U09004
3	1" Type 21 John Crane Seal	1	See Kits
4	Stub Shaft, 416ss	1	47U09018
5	Impeller - HS 150 5050	1	47U09055
	Impeller - HS 150 7575		47U09060
6	Pump Volute	1	47U09068
8	Volute Gasket	1	See Kits
9	5/16-18 x 3/8" Shaft Set Screw	2	See Kits
10	Woodruff Key	1	See Kits
11	1/2-13 x 3/4" Cap Screws	4	See Kits
12	5/16-18 x 1" Cap Screws	6	See Kits
15	1/4" Pipe Plug	1	See Kits
16	1/8" Pipe Plugs	4	See Kits
17	Impeller Washer	1	See Kits
18	Washer	1	See Kits
20	5/16-18 x 3/4" Cap Screw	1	See Kits

Part Lists and Diagrams (Model A)

Pos. No.	Description	# Used	Part No. *
4	Stub Shaft - HS 100 & 125	1	Brass-47U09011
	Stub Shaft - HS 100 & 125	1	416ss-47U09012
	Stub Shaft - HS 150 2020 & 3030	1	416ss-47U09015
	Stub Shaft - HS 150 5050 & 7575	1	416ss-47U09017

* Part numbers listed indicate the part is available separately. If "See Kits" appears after the part name, the part is only available in a kit.

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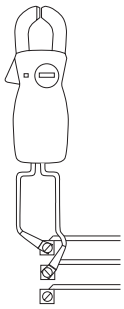
Troubleshooting

WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. It is recommended that rubber gloves and boots be worn, and metal terminal boxes and motors be properly grounded before any work is done.

WARNING: Failure to ground the pump may result in serious electrical shock.

Preliminary tests

Supply voltage



How to measure

Use a volt meter (set to proper scale) to measure the voltage at the pump terminal box or starter.

On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1

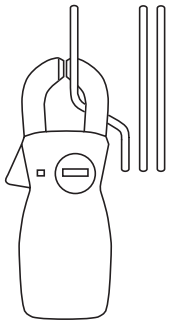
What it means

When the motor is under load, the voltage should be within ± 10% of the nameplate voltage. Larger voltage variation may cause winding damage.

Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.

If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

Current measurement



How to measure

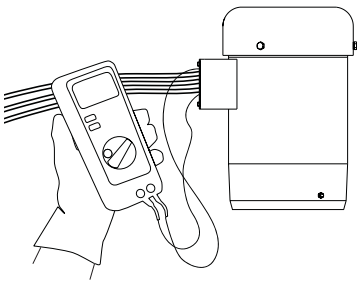
Use an ammeter (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.

Current should be measured when the pump is operating at constant discharge pressure.

What it means

If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:

1. Burned contacts on the motor starter.
2. Loose terminals in starter or terminal box or possible wire defect.
3. Too high or too low supply voltage.
4. Motor windings are shorted or grounded. Check winding and insulation resistances.
5. Pump is damaged causing a motor overload.



How to measure

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to R x 100K and zero adjust the meter.

Measure and record the resistance between each of the terminals and ground.

What it means

Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, the motor should be repaired or replaced.

Troubleshooting Chart

Fault	Possible causes	How to check	How to fix
A. Pump does not run.	1. No power at motor.	Check for voltage at motor terminal box.	If no voltage at motor, check feeder panel for tripped circuits and reset circuit.
	2. Fuses are blown or circuit breakers are tripped.	Turn off power and remove fuses. Check for continuity with ohm meter.	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electical installation, motor, and wires must be checked.
	3. Motor starter overloads are burned or have tripped out.	Check for voltage on line and load side of starter.	Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	4. Starter does not energize.	Energize control circuit and check for voltage at the holding coil.	If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.
	5. Defective controls.	Check all safety and pressure switches for operation. Inspect contact in control devices.	Replace worn or defective parts or controls.
	6. Motor is defective.	Turn off power and disconnect wiring. Measure the lead to lead resistances with the ohm meter (R x 1). Measure lead to ground values with ohm meter (R x 100K). Record measured values.	If an open or grounded winding is found, remove the motor and repair or replace.
	7. Defective capacitor (single-phase motors)	Turn off power and discharge capacitor. Check with ohm meter (R x 100K).	When the meter is connected to the capacitor, the needle should jump towards "0" ohms and slowly drift back to infinity. Replace capacitor if defective.
	8. Pump is bound.	Turn off power and manually rotate pump shaft.	If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
B. Pump runs but at reduced capacity or does not deliver water.	1. Wrong rotation.	Check wiring for proper connections.	Correct wiring.
	2. Pump is not primed or is air bound.	Turn pump off, close isolation valve(s), and remove the priming plug. Check fluid level.	Refill the pump, replace the plug, and start the pump. Long suction lines must be filled before starting the pump.
	3. Strainer, check valve, or foot valve is clogged.	Remove strainer, screen or valve and inspect.	Clean and replace. Reprime the pump.
	4. Suction lift is too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data.	Reduce suction lift by lowering the pump, increasing the suction line size, or removing high friction loss devices.
	5. Suction and/or discharge piping leaks.	Pump runs backwards when turned off. Air in suction pipe.	Suction pipe, valves, and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	6. Pump is worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shut-off.	Convert PSI to feet (Measured PSI x 2.31 ft. / PSI = ____ft.) Refer to the specific pump curve for shut-off head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	7. Pump impeller or connection port is clogged.	Disassemble and inspect pump passageways.	Remove any foreign materials found.

Troubleshooting Chart

Fault	Possible causes	How to check	How to fix
C. Pump cycles too much	1. Pressure switch is not properly adjusted or is defective.	Check pressure setting on switch and operation. Check voltage across closed contacts.	Readjust switch or replace if defective.
	2. Level control is not properly set or is defective.	Check setting and operation.	Readjust setting (refer to level control manufacturer's data). Replace if defective.
	3. Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume.	Replace as necessary.
	4. Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure.	Replace tank with one of correct size.
	5. Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings.	Convert PSI to feet (Measured PSI x 2.31 ft. / PSI = ____ft.) Refer to the specific pump curve for that model. Ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow is necessary.
D. Fuses blow or circuit breakers or heaters trip	1. Low voltage.	Check voltage at starter panel and motor.	If voltage varies more than ± 10%, contact power company. Check wire sizing.
	2. Starter overloads are set too low.	Cycle pump and measure amperage.	Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current.
	3. Three phase current is imbalanced.	Check current draw on each lead to the motor.	Must be within ± 5%. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	4. Motor is shorted or grounded.	Turn off power and dissconnect wiring. Measure the lead-to-lead resistance with an ohm meter (R x 1). Measure lead-to-ground values with an ohm meter (R x 100K) or a megaohm meter. Record values.	If an open or grounded winding is found, remove the motor, repair and/or replace.
	5. Wiring or connections are faulty.	Check proper wiring and loose terminals.	Tighten loose terminals. Replace damaged wire.
	6. Pump is bound.	Turn off power and manually rotate pump shaft.	If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.
	7. Defective capacitor (single-phase motors).	Turn off the power and discharge the capacitor. Check with ohm meter (R x 100K).	When the meter is connected to the capacitor, the needle should jump toward "0" ohms and slowly drift back to infinity. Replace if defective.
	8. Motor overloads at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near the overloads and motor. Record these values.	If ambient temperature at motor is lower than at the overloads, especially where temperature at overloads is above 104°F ambient compensated heaters should replace standard heaters.

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BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

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